Circuit-Bend Your Casio SK Keyboard

Written By: Cristiana Yambo

TOOLS:

- Drill and drill bits (1)
- Electrical Tape (1)
- Glue gun and hot glue (1)
- Multimeter (1)
- Multiple voltage transformer (optional) (1)
- Rotary tool and bits (1)
- Soldering equipment (1)

PARTS:

- Casio SK-series keyboard (1)
  We used an SK-5, but they're all great for bending. Check local thrift stores or eBay.
- Stranded wire 22- gauge or thereabouts (1)
- Small machine screws and nuts (1)
  At least 77 of each.
- Flat non-conducting easily drillable box (1)
  For the patch bay, we used a translucent plastic storage box. The patch bay box should be big enough to hold and permit access to 77 screws without crowding.
- Flat non-conducting box (1)
  Like above, but smaller; for external key box controller (optional)
- Assorted switches contacts and other

bend components (1)
For the control panel. We used 4 toggle switches, 1 potentiometer, 1 photometer, 2 doorknobs (for body contacts), and a pushbutton momentary switch to reset the device.

- Flat non-conducting easily drillable panel about 5"x5" (1)
  For the control panel, which fits over the keyboard's speaker area.
- Hose clamps (2) (1)
- Alligator clips (1)
  At least a few; the more, the merrier.
- Ethernet cable (1)
  For external controllers (optional)
- Ethernet jack (1)
  For external controllers (optional)
- Flexible plastic tubing (1)
- Momentary switches (1)
  We used keyboard keys from an old Macintosh. In many older, heavier computer keyboards, each key is its own selfcontained momentary switch (not shown).

SUMMARY

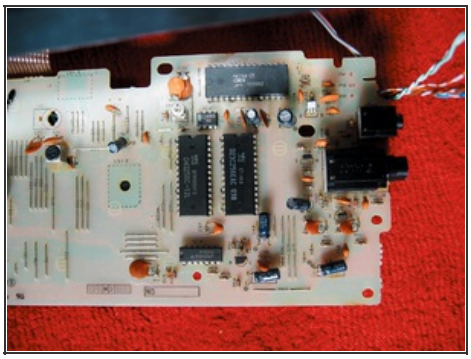
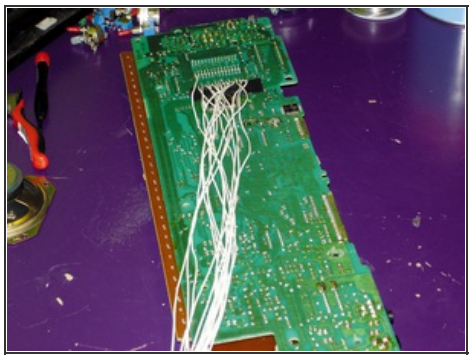
By Cristiana Yambo and Sebastian Boaz

The easiest way to start circuit bending is “playing open circuits.” That’s where you open up an audio device and use your hands or alligator clips to mess with the board inside and see what it sounds like. But it’s almost as easy to permanently “bend” any suitable device by soldering on a few wires and switches. We’ll explain how, and then show you how we transformed a Casio SK-5, a common, 80s-era sampling keyboard, into an unstoppably

flexible sound organ and sonic effects generator.

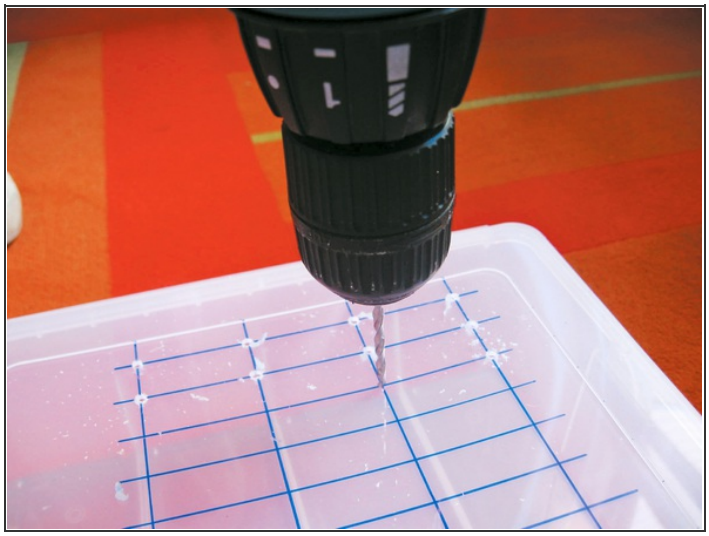
A word of caution: Do not attempt to circuit bend anything that needs to be plugged into a wall, such as a VCR or a television. These devices use high voltages, and playing with the circuitry inside might injure or kill you. Circuit bending is for battery-powered toys and instruments only.

Step 1 — Connect the patch wires.

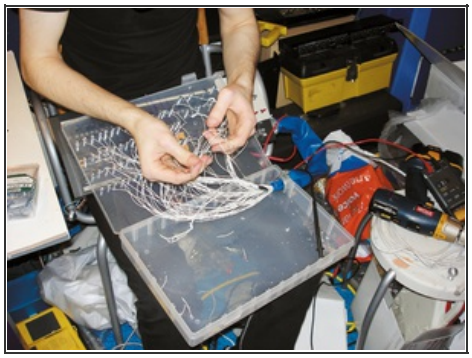
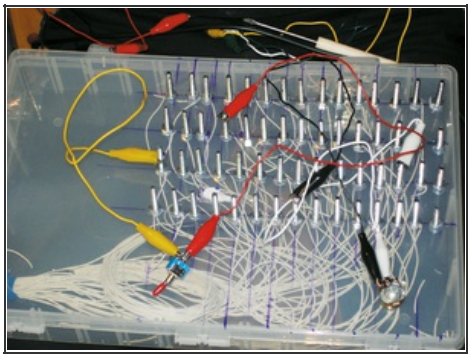

- The chips on Casio SK keyboards contain vast potential for unruly sounds, and wiring up a patch bay unlocks all of it by making every possible pin-to-pin connection available.
- Find the main chips. Open the case, remove the motherboard, and identify the main sound processing chips; these are two large, rectangular chips next to each other in the middle of the board. Each has 14 pins per side, a total of 56 pins. Turn the board over and find the points of these pins on the underside. You will solder one wire to each of these.
- Solder and check wires. For each row of 14 main chip pins, solder 14 lengths of wire, each around 30 inches long, to the contact points underneath. Carefully check each pin for solder bridges. When you finish a row, replace the board and play the keyboard to see if it still works normally. If it makes any weird sounds, you probably bridged two pins together. You can also use your multimeter to test pairs of wires for continuity and resolder wherever you find one.
- Insulate. Once each row passes its test, cover its pins in electrical tape, and wrap the wires in electrical tape to create a nice cable. After you've soldered and checked all four rows, remove the tape covering the pins and test the unit again. When it passes the test, warm up your glue gun and cover each row in hot glue. This holds the wires in place and insulates the connections to prevent unintended short circuits.

Step 2 — Build and connect the patch bay.



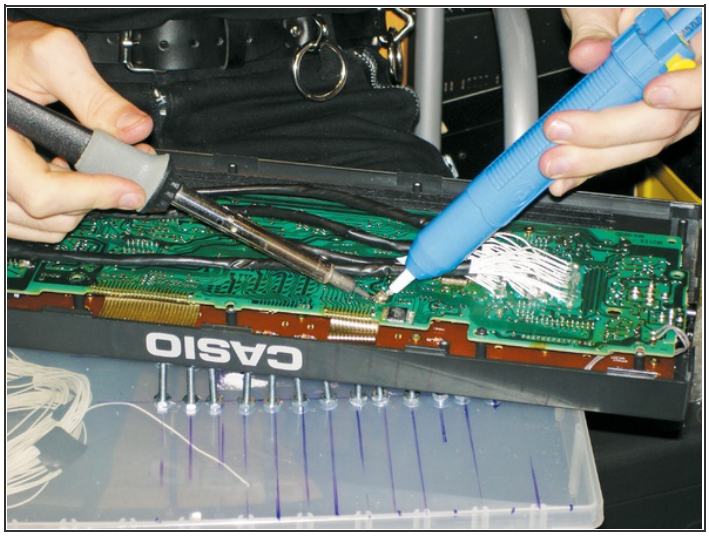
- Some people construct patch bays using RCA jacks, but screws and alligator clips are cheaper, more compact, and they let you connect multiple clips to the same point, which vastly expands the sonic possibilities.
- Drill the holes. Measure, mark, and drill 60 holes in the patch bay box, four rows of 15, one for each of the 56 wires, plus four jumper points on the side to facilitate multiple connections. The holes should fit your screws snugly. Leave room for another, smaller set of holes for the control panel which you'll drill later.
- Insert the screws. Bolt screws into the holes, with the heads on the inside and the shafts pointing out.
- Make the patch cable. Count your control panel components, and then strip and cut enough wires to connect to each of these, plus two more for the tuning circuit; we used 17 total. You'll connect these wires later, so it helps to include some extra ones and label which ends connect to one another. Gather them together with four taped-together sets of patch wires, to make a super-cable that will run between the keyboard and patch bay. Secure each end with hose clamps, and push it through the plastic tube.

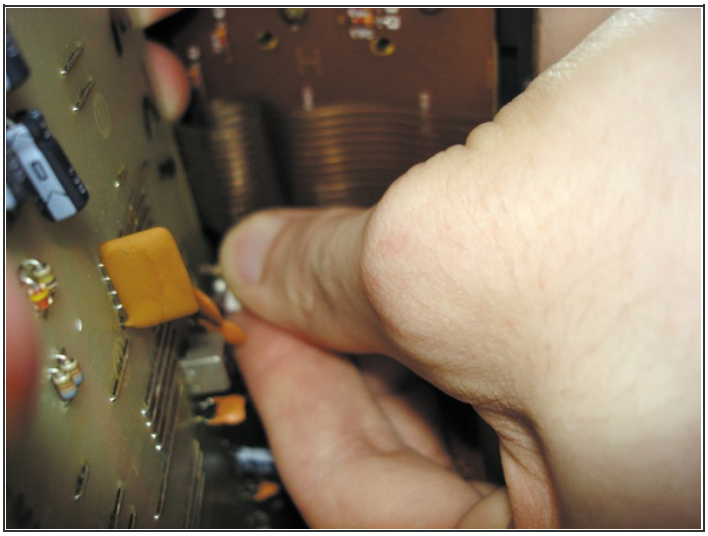
Step 3

- Route the patch cable. Cut a large hole in the side of the patch bay box. Insert the patch cable and secure it by hot-gluing the hose clamp to the box.
- Connect the patch wires. Now it's time to wire the screws. Wrap the end of each patch wire clockwise underneath the head of each screw and tighten the bolt to secure the wire. Connect each group of 14 patch wires to a different row on the patch bay.
- Test the board. Using alligator clips, connect switches and pots between different patch points, play the keyboard, and see how it works. Operating the components and changing their configuration should yield different sounds.

Step 4 — Remove the tuning pot.



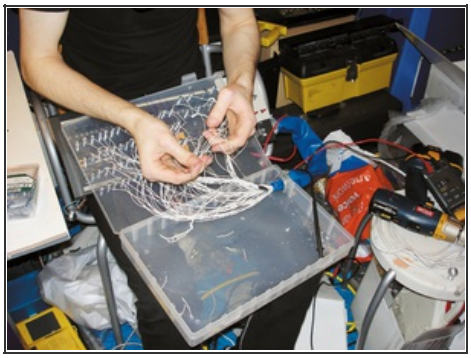
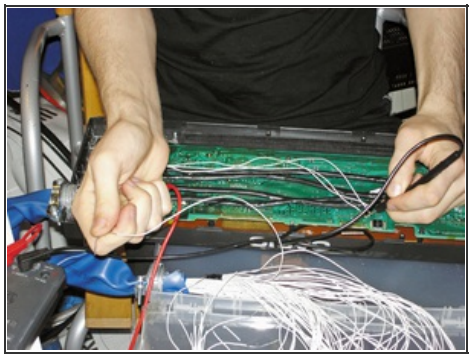
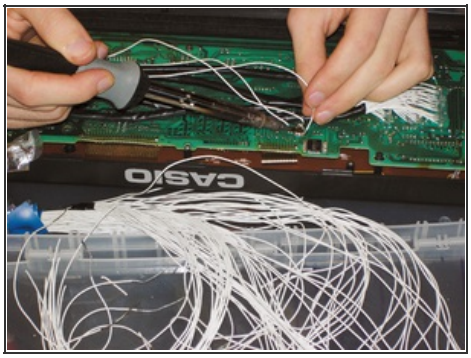


- Many old electronic instruments easily lose their tuning and have a small potentiometer that adjusts them back into tune. We'll bring this component's connections out to our patch bay, so you can create bends that alter the pitch of the entire keyboard.
- Unsolder the pot. The SK's tuning pot is normally accessed through a hole in the underside of the keyboard, in the center, and you adjust it with a small screwdriver. Find the component on the board and use a solder sucker or desoldering braid to remove all of the solder.
- Pull out the tuning pot. You will probably have to use some force. Then mark where it was located, to help you find it later.

Step 5 — Build the control panel.

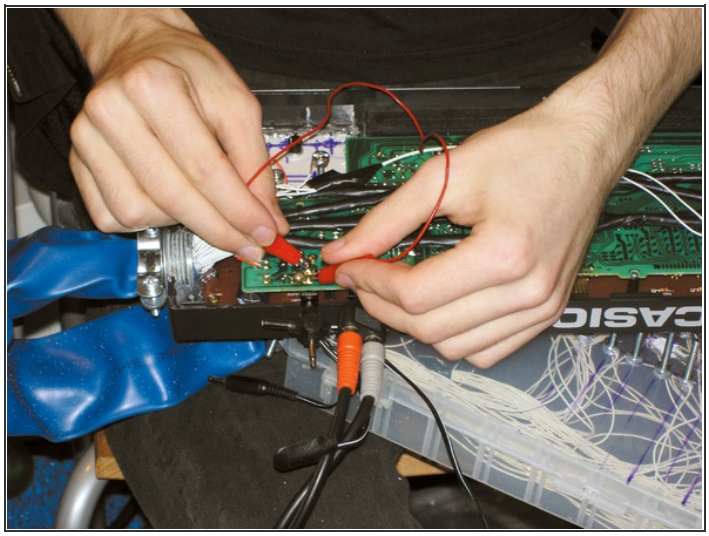
- The control panel houses interface components which you can hook into any circuit bends via the patch bay. It also has the reset button, a momentary switch that restarts the instrument after a crash.
- Using a rotary tool, cut out the speaker grill. This hole is going to be used to house the interface elements.
- Build the control panel. Attach your components to the panel. For ours, we drilled holes in a piece of hard plastic and then hot-glued in our components: four toggle switches, a pair of doorknobs for body contacts, a potentiometer (separate from the tuning pot), a photometer for lightsensitive distortions, and a momentary switch, which will act as a reset button.

Step 6 — Connect the control panel.

- Finish the patch bay. Drill holes and install screws in the patch bay, as in Step 2. You'll need the appropriate number of contact points for each component on the control panel, plus two more to lead to the tuning pot's contacts on the circuit board. Arrange the holes in the same way that your components are arranged on the control panel. This makes it easy to remember which contact point on the bay corresponds to which control.
- Wire the control panel. Now you're going to use the extra wires in the cable. If they aren't labeled, use a multimeter to identify matching ends. Then connect the control panel components to the new patch bay array, following your logical mapping. Screw the wires to the patch bay points as before, and solder the other ends to the components.
- Connect the tuning circuit. Screw two remaining extra wires to the tuning-circuit points on the patch bay and solder the other ends to the tuning pot contacts on the board.

Step 7 — Connect the reset, and close it up.



- Bent instruments sometimes crash in a way that disables the power switch. One solution is to wire a momentary switch between the positive power line and the circuit board, but with the SK-5 it's easier to install a switch that connects the positive and negative power lines, momentarily shorting them out.
- Connect the reset button. Solder the reset button's contacts to the positive and negative terminals that lead from the battery compartment.
- Hot-glue the control panel to the case.
- Close up the case. Screw it together, switch it on, and then rock out with the ultimate SK!
- Extend the capabilities of your new keyboard by adding an external controller port and making two kinds of external controllers. Visit makezine.com for complete instructions.

This project first appeared in MAKE Volume 04, page 88.

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